

WHAT IS CLAIMED IS:

1. A piezoelectric porcelain composition containing,

5 a complex oxide having a perovskite structure mainly composed of Pb, Zr and Ti; and

the following component (a) and/or (b):

(a) Ag and/or an Ag compound, and Mo and/or an Mo compound

(b) silver molybdate $[\text{Ag}_2\text{MoO}_4]$

10 2. A piezoelectric porcelain composition,

wherein the composition is made by adding Ag and/or an Ag compound, and Mo and/or an Mo compound to a complex oxide having a perovskite structure mainly composed of Pb, Zr and Ti, and

15 wherein the composition contains a silver molybdate $[\text{Ag}_2\text{MoO}_4]$.

3. A piezoelectric porcelain composition comprising,

20 a complex oxide having a perovskite structure mainly composed of Pb, Zr and Ti; and

0.12 mol% to 0.36 mol% of silver molybdate $[\text{Ag}_2\text{MoO}_4]$.

4. A piezoelectric porcelain composition,

25 wherein the composition is made by adding Ag and/or an Ag compound, and Mo and/or an Mo compound to a complex oxide having a perovskite structure mainly

composed of Pb, Zr and Ti, and

wherein respective amount of Ag and Mo calculated as Ag_2O and MoO_3 satisfy all of the following expressions (i) to (iii):

- 5 Ag_2O amount - MoO_3 amount ≤ 0.12 mol% (i)
 0.24 mol% $\leq \text{Ag}_2\text{O}$ amount ≤ 0.48 mol% (ii)
 0.12 mol% $\leq \text{Mo}_3\text{O}$ amount ≤ 0.36 mol% (iii)

5. A piezoelectric porcelain composition according to one of claims 1 to 4,

10 wherein the composition further contains lead molybdate $[\text{Pb}_2\text{MoO}_5]$.

6. A piezoelectric porcelain composition containing a complex oxide having a perovskite structure mainly composed of Pb, Zr and Ti; and the following component (A) and/or (B):

(A) Ag and/or an Ag compound, Mo and/or an Mo compound, and W and/or a W compound

(B) silver molybdate-tungstate $[\text{Ag}_2\text{Mo}_{(1-x)}\text{W}_x\text{O}_4]$ (where X is a number from 0.3 to 0.7)

20 7. A piezoelectric porcelain composition,
 wherein the composition is made by adding Ag and/or an Ag compound, Mo and/or an Mo compound, and W and/or a W compound to a complex oxide having a perovskite structure mainly composed of Pb, Zr and Ti,
 25 and

 wherein the composition contains silver molybdate-

tungstate $[\text{Ag}_2\text{Mo}_{(1-x)}\text{W}_x\text{O}_4]$ (where X is a number from 0.3 to 0.7).

8. A piezoelectric porcelain composition comprising,

5 a complex oxide having a perovskite structure mainly composed of Pb, Zr and Ti; and

0.12 mol% to 0.36 mol% of silver molybdate-tungstate $[\text{Ag}_2\text{Mo}_{(1-x)}\text{W}_x\text{O}_4]$ (where X is a number from 0.3 to 0.7).

10 9. A piezoelectric porcelain composition,

wherein the composition is made by adding Ag and/or an Ag compound, Mo and/or an Mo compound, and W and/or a W compound to a complex oxide having a perovskite structure mainly composed of Pb, Zr and Ti,
15 and

wherein respective amount of Ag, Mo and W calculated as Ag_2O , MoO_3 and WO_3 satisfy all of the following expressions (1) to (3):

20 $\text{Ag}_2\text{O amount} - ((1-X) \cdot \text{MoO}_3 + X \cdot \text{WO}_3) \text{ amount} \leq 0.12$
mol% (1)

$0.24 \text{ mol\%} \leq \text{Ag}_2\text{O amount} \leq 0.48 \text{ mol\%}$ (2)

$0.12 \text{ mol\%} \leq (\text{Mo}_3\text{O} + \text{WO}_3) \text{ amount} \leq 0.36 \text{ mol\%}$ (3)

where X is a number from 0.3 to 0.7.

25 10. A piezoelectric porcelain composition according to one of claims 6 to 9,

wherein the composition further contains lead

molybdate-tungstate $[\text{Pb}_2\text{Mo}_{(1-x)}\text{W}_x\text{O}_4]$ (where X is a number from 0.3 to 0.7).

11. A piezoelectric porcelain composition according to one of claims 1 to 10,

5 wherein the complex oxide further contains Zn, Mg and Nb.

12. A piezoelectric porcelain composition according to one of claims 1 to 11,

10 wherein the complex oxide is $a\text{Pb}(\text{Zn}_{1/3}\text{Nb}_{2/3})\text{O}_3 - b\text{Pb}(\text{Mg}_{1/3}\text{Nb}_{2/3})\text{O}_3 - c\text{PbTiO}_3 - d\text{PbZrO}_3$ (where $a+b+c+d=1$).

13. A piezoelectric body formed by firing the piezoelectric porcelain composition according to one of claims 1 to 4,

15 wherein the piezoelectric body contains silver molybdate $[\text{Ag}_2\text{MoO}_4]$.

14. A piezoelectric body formed by firing the piezoelectric porcelain composition according to one of claims 1 to 5,

20 wherein the piezoelectric body contains silver molybdate $[\text{Ag}_2\text{MoO}_4]$ and lead molybdate $[\text{Pb}_2\text{MoO}_5]$.

15. A piezoelectric body formed by firing the piezoelectric porcelain composition according to one of claims 6 to 9,

25 wherein the piezoelectric body contains silver molybdate-tungstate $[\text{Ag}_2\text{Mo}_{(1-x)}\text{W}_x\text{O}_4]$ (where X is a number from 0.3 to 0.7).

16. A piezoelectric body formed by firing the piezoelectric porcelain composition according to one of claims 6 to 10,

5 wherein the piezoelectric body contains silver molybdate-tungstate $[\text{Ag}_2\text{Mo}_{(1-X)}\text{W}_X\text{O}_4]$ (where X is a number from 0.3 to 0.7) and lead molybdate-tungstate $[\text{Pb}_2\text{Mo}_{(1-X)}\text{W}_X\text{O}_4]$ (where X is a number from 0.3 to 0.7).

17. A single-plate piezoelectric device comprising, two electrodes opposing each other, and a piezoelectric layer disposed between the electrodes,

10 wherein the piezoelectric layer comprises the piezoelectric porcelain composition according to one of claims 1 to 12.

18. A single-plate piezoelectric device comprising, two electrodes opposing each other, and a piezoelectric layer disposed between the electrodes,

15 wherein the piezoelectric layer comprises the piezoelectric body according to one of claims 13 to 16.

19. A laminated piezoelectric device comprising, an inner electrode, a piezoelectric layer, and an outer electrode,

20 wherein the inner electrode and the piezoelectric layer are laminated alternately, and the inner electrode is connected to the outer electrode, and

25 wherein the piezoelectric layer comprises

the piezoelectric porcelain composition according to one of claims 1 to 12.

20. A laminated piezoelectric device comprising, an inner electrode, a piezoelectric layer, and an outer electrode,

wherein the inner electrode and the piezoelectric layer are laminated alternately, and the inner electrode is connected to the outer electrode, and

wherein the piezoelectric layer comprises the piezoelectric body according to one of claims 13 to 16.

21. A laminated piezoelectric device comprising, an inner electrode, a piezoelectric layer, and an outer electrode,

wherein the inner electrode and the piezoelectric layer are laminated alternately, and the inner and outer electrodes are connected to each other via a conductor within a through hole formed in the laminating direction, and

wherein the piezoelectric layer comprises the piezoelectric porcelain composition according to one of claims 1 to 12.

22. A laminated piezoelectric device comprising, an inner electrode, a piezoelectric layer, and an outer electrode,

wherein the inner electrode and the piezoelectric layer are laminated alternately, and the inner and outer electrodes are connected to each other via a conductor within a through hole formed in the laminating direction, and

wherein the piezoelectric layer comprises the piezoelectric body according to one of claims 13 to 16.

23. A laminated piezoelectric device according to one of claims 19 to 22,

wherein the inner electrode comprises Ag.

24. A method of making a piezoelectric porcelain composition which comprises:

a step of forming a complex oxide having a perovskite structure by temporarily firing a material containing Pb, Zr, and Ti; and

a step of adding Ag and/or an Ag compound, and Mo and/or an Mo compound to the complex oxide.

25. A method of making a piezoelectric porcelain composition which comprises:

a step of forming a complex oxide having a perovskite structure by temporarily firing a material containing Pb, Zr, and Ti; and

a step of adding silver molybdate $[Ag_2MoO_4]$ to the complex oxide.

26. A method of making a piezoelectric porcelain composition which comprises:

a step of forming a complex oxide having a perovskite structure by temporarily firing a material containing Pb, Zr, and Ti; and

5 a step of adding Ag and/or an Ag compound, Mo and/or an Mo compound, and W and/or a W compound to the complex oxide.

27. A method of making a piezoelectric porcelain composition which comprises:

10 a step of forming a complex oxide having a perovskite structure by temporarily firing a material containing Pb, Zr, and Ti; and

a step of adding silver molybdate-tungstate $[Ag_2Mo_{(1-X)}W_XO_4]$ (where X is a number from 0.3 to 0.7) to the complex oxide.

15 28. A method of making a piezoelectric device which comprises:

a step of firing the piezoelectric device precursor before final firing comprising the piezoelectric porcelain composition according to one of
20 claims 1 to 12 at a firing temperature of 850°C to 950°C.